Fixing (?) the Shortcomings of Map-based Approaches

MAP of the INTERNET
THE IPv4 SPACE, 2006

http://xkcd.com/195/

Provisioned Bandwidth Information

- Applications <u>may want</u> to use it
  - Ono and P4P experiments show higher improvement in high-capacity areas
- ISPs <u>have</u> it and <u>may want</u> applications to use it
  - "Try local power-users before going to Korea!"
- BTW, it's in the charter...

Problem (Part 1)

- IP of residential customers primarily assigned on a topological basis
  - In the same area addresses often taken from the same pool regardless of the subscription class

  i.e.

- Prefix matching **<u>inefficient</u>** for identifying access line characteristics
  - Cannot tell between 50/10 and 2/.384 lines

Example (Priority Maps)

Topology only

```
83.128.0.0/10  → 20  /* Local AS */

83.128.0.0/12  → 30  /* Local PoP */

85.128.0.0/9   →  4

91.0.0.0/10    → 10  /* Peering agr */

99.98.0.0/16   →  5

202.0.0.0/8    →  0  /* Australia!!! */

204.2.0.0/16   →  7

...
```

Topology <u>and</u> bandwidth

```
83.123.21.45/32  → 30  /* 50/10 */

83.123.21.46/32  → 20  /* 20/2*/

83.123.21.47/32  →  1  /* Dialup */

83.123.21.48/31  → 30  /* 2 in a row! */

83.123.21.50/32  → 10  /* 10/1 */

83.123.21.50/32  → 30  /* 50/10 */

83.123.21.51/32  → 20  /* 20/2 */

...
```

Problem (Part 2)

- IP addresses of residential lines often assigned dynamically

i.e.

- Address-by-address maps **stale** as soon as the first home gateway reboots
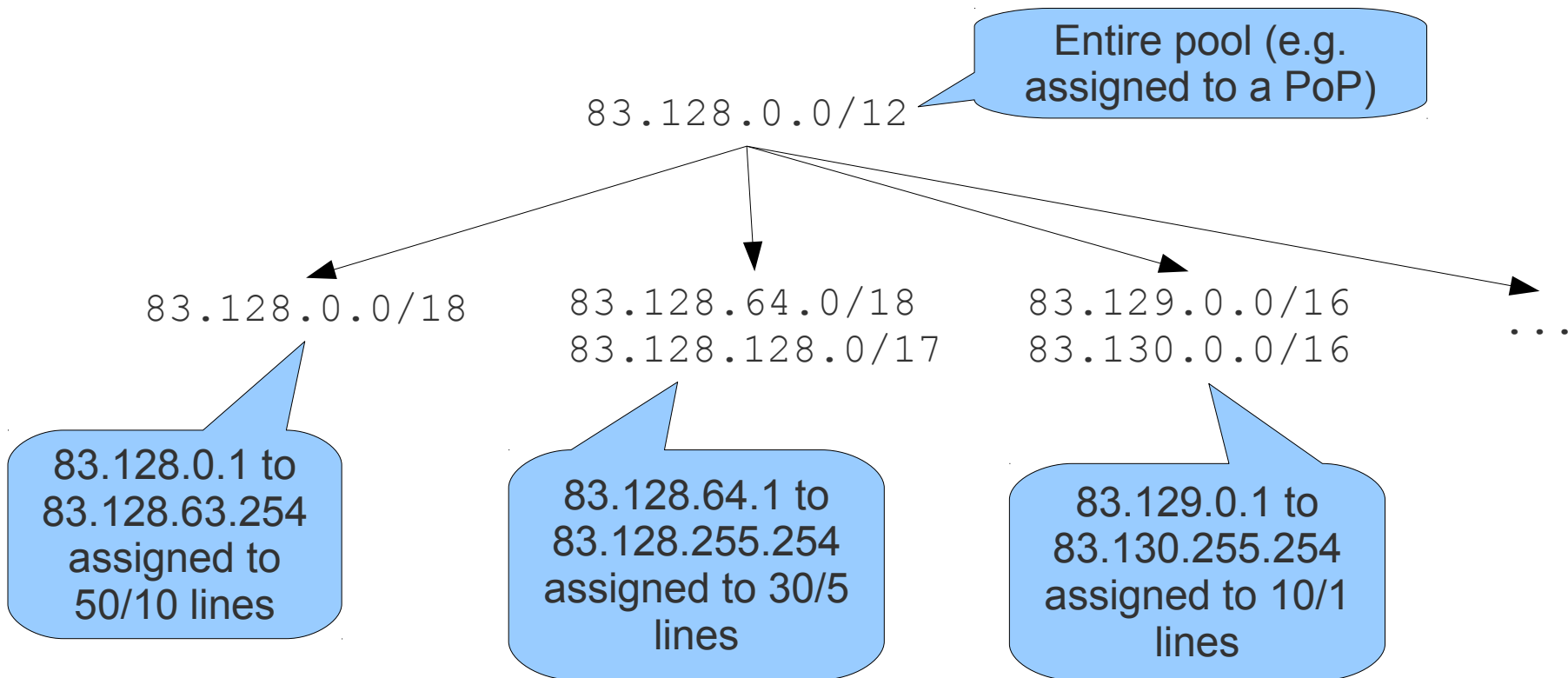
Question: Is it *desirable* to be able to provide guidance based on provisioned bandwidth? (Or on anything other than topology?)
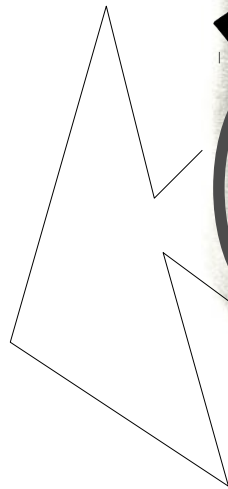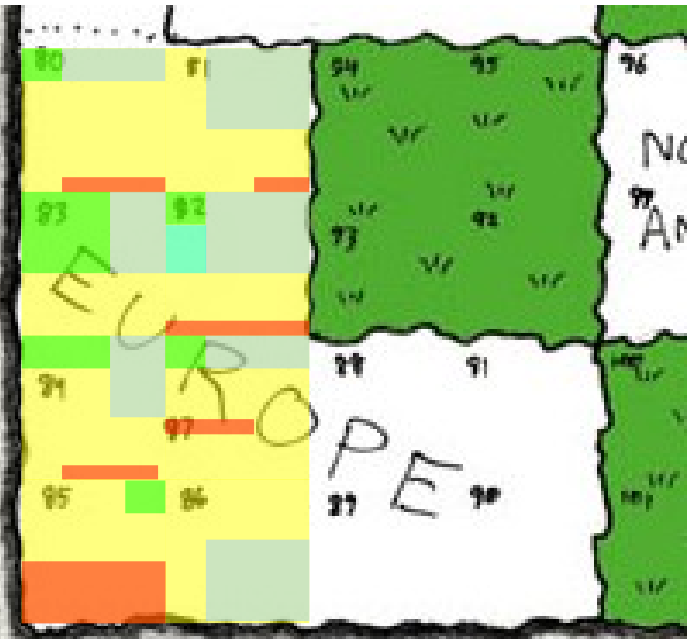
Suggested answer: Yes, if reasonably feasible

- Huge, short-lived maps may turn out generating more traffic than the application itself

- Applications <u>may not want</u> to give privacy in exchange BitTorrent won't send lists of IP addresses to ISPs, no matter how accurately they can do the ranking

Approach #1

- **Adapting** IP provisioning policies to reflect provisioned bandwidth

  - Multi-level network partitioning

83.128.0.0/12 — Entire pool (e.g. assigned to a PoP)

83.128.0.0/18

83.128.64.0/18
83.128.128.0/17

83.129.0.0/16
83.130.0.0/16

...

83.128.0.1 to 83.128.63.254 assigned to 50/10 lines

83.128.64.1 to 83.128.255.254 assigned to 30/5 lines

83.129.0.1 to 83.130.255.254 assigned to 10/1 lines

LOCAL

PUBLIC DATA NETS · HP · DEC · FORD · CSC · DDN-RVN · 234 235 236 237 240 241 254 255

GENERAL ELECTRIC · XEROX · BELL LABS · APPLE · MIT · DISA · 233 232 237 238 245 246 253 252

MULTICAST

BBN INC · BBN INC · DoD INTEL · DISA · CABLE TV · UK MoD · 230 231 226 225 244 247 248 251

ARMY AISC · IBM · VPNs · DSI · DISA · 229 228 227 224 243 246 249 250

SITA · MERC · CAP DEBIS CCS · NORSK · MERIT · ASIA-PACIFIC · 218 219 220 ASIA-PACIFIC · LATIN AMERICA · US/VARIOUS

ASIA-PACIFIC · UPS · BOEING · duPont · DLA · HALLIBURTON · PSI · EUROPE · NORTH AMERICA · NORTH AMERICA · AFRICA

EUROPE · UK SOCIAL SECURITY · BBN INC · INTEROP · ELI LILLY · ARINIC · US DEPARTMENT OF DEFENSE · NORTH AMERICA · EUROPE

EUROPE · BELL NORTH · PRUDENTIAL · HAM RADIO · JAPAN INET · EUROPE · ASIA-PACIFIC · JAPAN · EUROPE VARIOUS

USA · DIGG · SLASHDOT EBAY TRANSLUT · ASIA-PACIFIC · LOOPBACK · JAPAN · 129 130 135 137

EUROPE · CANADA · NORTH AMERICA · VARIOUS · LATIN AMERICA & CARIBBEAN

REGISTRARS

you are here

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Approach #1: Pros and Cons

Pros

- Still a map
  - Simple, simplest

Cons

- May require radical changes in ISPs' provisioning policies
- Additional partitioning unlikely to reflect different parameters (bandwidth, latency...)
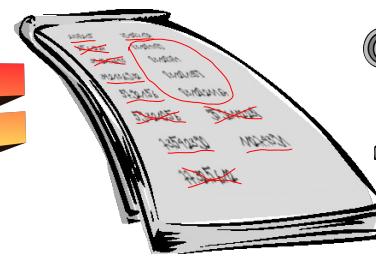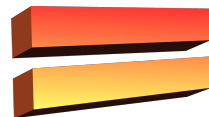- May result in big files

Approach #2

- Fine-grain guidance in an additional step
  - First: a high-level map
    - "Prefer Korea, avoid Australia..."
  - Then: [take a deep breath] an accurate query/response service for areas where more detailed information is available
- Steps *almost* completely disjointed
  - Maps may point to second-step servers
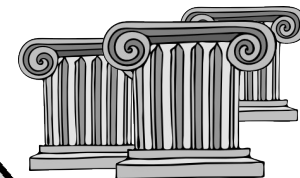   - "Prefer Korea, avoid Australia, detailed information about Japan available at xyzp://oracle.isp.jp..."
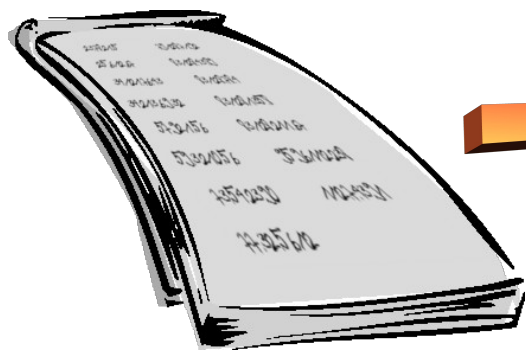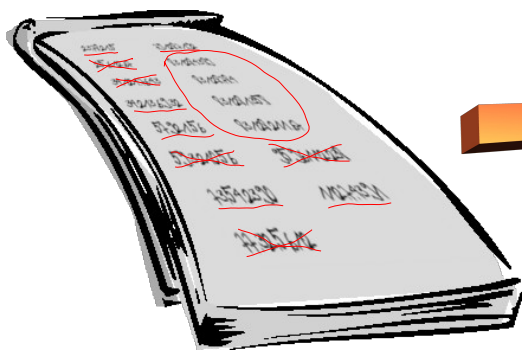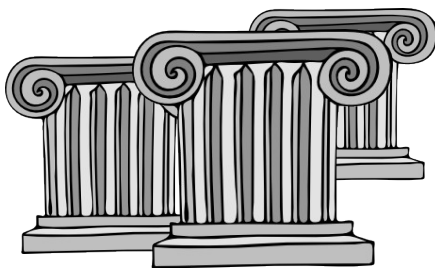
Peer List + **Preference Map** = **Coarse-grain Refined List** **Oracle Location(s)**
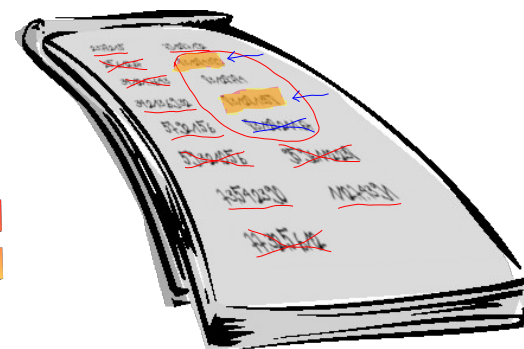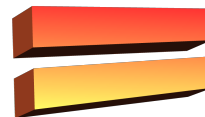
Coarse-grain Refined List + **Oracle(s)** = **Fine-grain Refined List**

Approach #2: Pros and Cons

Pros

- No impact on ISP infrastructure/policies

- Incremental solution

  - Not a one-size-fits-all
  - Can stop at step 1

Cons

- Added complexity

  - Discovery of maps <u>and</u> oracles

  - One protocol or two protocols?

- Privacy

  - Not all users will be happy with step 2

Approach #3

- Click to add your favorite solution

We don't need answers now, but...

At some point we'll have basically two options:

- Ignore everything that does not fit on a map
    - Provisioned bandwidth <u>is not</u> available bandwidth
    - IP assignment policies are <u>just policies</u>
    - Just topology is still better-than-random

- Design alternatives/complements to prefix-matching
    - Efficiency (no, /30 is not prefix-matching!)